National Bureau of Standards

TECHNICAL NEWS BULLETIN

APRIL 1946 No. 348

Sunspots and Radio Communication

One of the largest sunspot groups ever seen crossed the solar disk between January 29 and February 11, 1946, and was accompanied by very pronounced radio and other terrestrial effects. A photograph of the sun as it appeared on February 3 is presented through the courtesy of the United States Naval Observatory. This sunspot group partially returned, after one rotation of the sun, between February 27 and March 13. It was again associated with terrestrial effects, though much less severe. The maximum area of the group on first passage in February was greater than 100 square degress of the sun's visible disk, or about 100 times the area of the earth. According to the United States Naval Observatory, the group was the largest on record since 1892; it was easily visible to the unaided eye through smoked glass.

The region around the sunspot was observed to be very bright in the light of the hydrogen alpha line, and several solar eruptions or flares were seen. Associated with these flares were sudden ionospheric disturbances manifested by radio fadeouts. These are caused by a sudden great increase in ultraviolet light, which creates such high ionization in the *D* region of the ionosphere that high-frequency radio sky waves are absorbed. These sudden fadeouts usually last from a few minutes to several hours. They are most severe on the lower of the high frequencies above the broadcast band. Propagation paths nearer the subsolar point (noon, equatorial region) are disturbed the most. As this type of disturbance is caused by a solar eruption, only a radio-propagation path, of which a part is in sunlight, is affected. The Bureau's radio receiving station at Sterling, Va., recorded sudden ionosphere disturbances on January 29, 30, and 31, and February 1, 2, 3, 6, 7, 8, 9, and 11 (i. e., almost every day while the sunspot was on the solar disk). The most severe of these was on February 6, when almost all signals were blacked out for 3½ hours. Five and a half hours passed before field intensities were fully recovered on some of the paths.

The leader spot began to pass the sun's central meridian on February 4, but the follower spot, which was the larger and more significant, did not pass the central meridian until the early hours of the Greenwich day of February 6. A little over 24 hours later, a period which agrees well with the theoretical time required for particles to travel from the sun to the earth, severe terrestrial disturbances were noted. Brilliant displays of aurora borealis were reported, with some auroral display actually visible at Washington on the nights of February 6 and 7. A great geomagnetic storm began suddenly at 1019 GCT on February 7, according to the Cheltenham, Md., magnetic observatory of the United States Coast and Geodetic Survey, and lasted until 2300 GCT on February 8. This very severe disturbance was followed by two moderate geomagnetic storms on February 9 and 10. Moderate storms had also been reported on February 3, 5, and 6. The level of horizontal magnetic intensity was abnormally low from February 7 through February 9 and remained below normal until February 12.

Warnings of the radio-transmission conditions expected because of this solar outbreak were issued by the Interservice Radio Propagation Laboratory at the Bureau. Daily warnings of disturbed radio conditions, primarily on transmission paths across the North Atlantic, were issued, February 7 to 11. In addition, the semiweekly forecasts issued February 1 and 5 predicted poor transmission for February 4 to 11. The daily warnings of expected disturbed conditions were broadcast from the Bureau's station WWV and by other means.

Reports subsequently received by the Bureau, on ionospheric and radio-traffic conditions, indicated that radio communications were severely disturbed at all latitudes north of Washington, on February 7 and 8, and were moderately disturbed from then on through February 11. This type of radio disturbance is characterized by rapid or flutter fading, accompanied by very weak field intensities. The higher frequencies are usually blacked out because of abnormal depression of the critical frequencies of the F2 layer of the ionosphere, and direction-finder observations become unreliable. After the most severe part of this disturbance was over, the daytime hours were characterized by very high absorption, as indicated by very weak field intensities. This prolonged type of disturbance is most noticeable on the radio-transmission paths crossing the auroral zone. For this reason the reception of all European stations in the United States was difficult or impossible during this ionosphere storm.

689259—46

The leader of the sunspot group returned to the solar disk on February 27 and the follower on February 28. The group as a whole was somewhat less than half of its original size but was still in the class of large sunspots. The follower, the significant part of the group, crossed the sun's central meridian on March 6 and was last seen on March 13. The group was shrinking in size as it disappeared from view. Although it is possible that the follower spot will return a second time about March 27, it probably will no longer be of the large sunspot class.

Sudden radio fadeouts were again associated with flares from the general region of the sunspot group. The Sterling, Va. station recorded sudden ionosphere disturbances on February 27 and 28, and March 1 and 8. The associated radio fadeouts lasted from one-half to 1½ hours. Thus, there were fewer disturbances of shorter duration with the return group than with the original group.

Geomagnetic storms were reported by the Cheltenham, Md., magnetic observatory on March 4 to 6, March 9, and March 10 to 11; the last was the most severe, but the disturbance was much less severe than the one that accompanied the original sunspot group.

Daily warnings of radio propagation disturbance were issued by the Bureau on March 5 and 6 and again on March 9, extending to March 12.

There was not an exact 27-day recurrence of the prolonged ionospheric disturbance of February 7 through 11, which was forecast as a possibility for March 6 through 9 in the semiweekly forecasts issued March 1 and 5. Rather, there was slight to moderate radio propagation disturbance indicated on March 5, with moderate disturbance beginning March 10 extending through March 11. Though the times of these disturbances did not show the expected relation with the central meridian passage of the sunspots, the region of the return sunspot group was the most likely source of disturbance visible on the sun.

Summarizing, severe radio and other terrestrial effects were very pronounced during the original passage of the sunspot goup in February, and were less pronounced during its return in March.

TECHNICAL NEWS BULLETIN

U. S. Department of Commerce
Henry A. Wallace, *Secretary*

National Bureau of Standards
E. U. Condon, *Director*

APRIL 1946 **Issued Monthly** **No. 348**

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Subscription price 50 cents a year; single copy, 5 cents. Published with approval of the Bureau of the Budget.

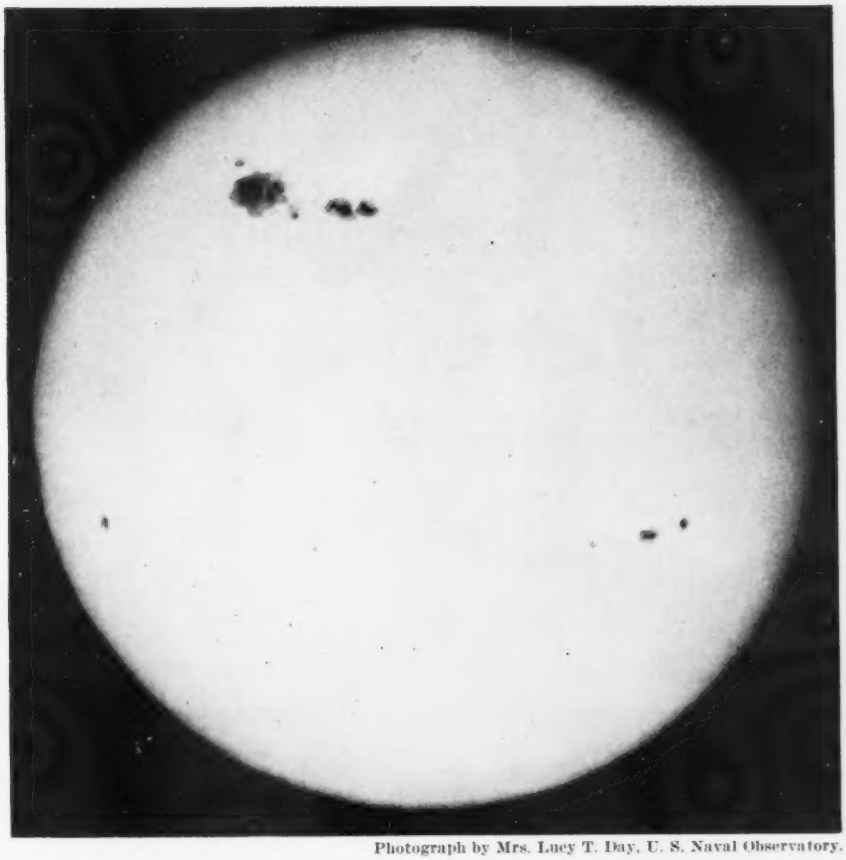
Contents

Classification of Radio Subjects

A new Letter Circular, LC814, entitled "Revised Classification of Radio Subjects Used in National Bureau of Standards," has just been released. This is an expansion and revision of NBS Circular C385, "Classification of Radio Subjects—An Extension of the Dewey Decimal System," published originally in the August 1930 issue of The Proceedings of the Institute of Radio Engineers. The Letter Circular is to be used in classifying references to radio literature, reports, books, or any materials or items of interest to workers in the radio field. Its numbers will be used hereafter in classifying the articles in The Proceedings of the Institute of Radio Engineers.

Intercomparison of the revision with the older publication shows the same basic classifications, but great expansion of some parts and some additions; in fact, one of the chief merits of the system is its capability of indefinite expansion. It is expected that additions to the present system will be made: (1) from suggestions received from users, (2) as the need develops, and (3) as secret material is unclassified.

The present revision, like the original NBS Circular C385, is based upon the twelfth edition (1927) of Melvin Dewey's book "Decimal Classification and Relative Index for Libraries, Clipping Notes, Etc.," and should not be confused with the fourteenth edition, 1942, of that book, which devoted some space to radio. The radio subjects covered in the book have numbers differing from those assigned in the Bureau's pamphlet. A copy of LC814 is available, without charge, from the National Bureau of Standards, Washington 25, D. C.



Photograph by Mrs. Lucy T. Day, U. S. Naval Observatory.

Largest sunspot group since 1892, shown as it appeared on February 3, 1946.

Naval Technical Mission to Japan

R. L. Sanford, chief of the Bureau's Magnetic Measurements Section, recently returned from Japan where he participated in a survey of the accomplishments of the Japanese during World War II in fundamental research and the development and application of magnetic materials. The survey was made at the request of the Bureau of Ordnance, Navy Department, by a group of specialists in the field of magnetics of which the Bureau's representative acted as chairman. The group also included Dr. G. W. Elmen of the Naval Ordnance Laboratory, Dr. R. W. Bozorth of the Bell Telephone Laboratories, W. D. Williams of the General Electric Co., and F. T. Chestnut of the Ajax Electrothermic Corporation.

In the course of the survey, visits were made to universities, technical laboratories, manufacturing plants, and steel mills where the leading scientists and engineers dealing with magnetic materials were interviewed. Among these were scientists of international reputation, including Dr. K. Honda, inventor of the well-known MK alloy, the forerunner of the alnico alloys; and Drs. Y. Kato and T. Takei, who originated the sintered oxide type of magnet material. Although most of the time was spent in the Tokyo area, visits were made to cities all the way from Sendai, in the northern part of Honshu to Fukuoka in Kyushu.

The Japanese without exception were cooperative and friendly and facilitated the work of the mission in many ways. Dr. Honda, for instance, entertained the group at his home, so that, as he explained, "they could not only discuss scientific developments, but could observe the mode of life of middle class people in Japan."

It is hoped that before long the technical information obtained by the mission will be declassified so that it can be made available to those interested.

Super High-Frequency Dielectric Measurements

Recent trends in the radio and television fields make it necessary to investigate the dielectric properties of insulating materials at super high frequencies. Some time ago the Clay and Silicate Products Division obtained an MIT coaxial wave guide instrument for measurement of the dielectric constant and dielectric loss of ceramic materials at frequencies of about 3,000 megacycles per second. Because a perfect fit is necessary between the test specimen and the wave guide, this instrument cannot be used with any precision for materials with a dielectric constant above about 100. So far, the dielectric constant and Q value have been determined in this instrument for specimens of quartz glass, corundum, spinel, and a material having the composition $BaO: 3TiO_2$, and they do not differ in order of magnitude from those obtained at a frequency of 1 megacycle per second. For example, at 1 megacycle per second, the dielectric constant and Q value for fused quartz are equal to 3.80 and 5,000, respectively, and at 3,000 megacycles the same values are obtained; for $BaO: 3TiO_2$, at one megacycle, the dielectric constant and Q values are 44 and 640 respectively, and at 3,000 megacycles are 42 and 460.

Serviceability of Optical Glass

Several modifications of a powder-hygroscopicity method have been tried as a rapid means of determining the serviceability of optical glasses, that is, their ability to maintain a clear polished surface under normal conditions of service. The method has been applied by Donald Hubbard, of the Bureau's Glass Section, to a wide variety of glasses and, as reported in the Journal of Research for April (RP1706), it shows that the typical optical glasses in common use are much less hygroscopic than the average commercial sheet and container glasses. In fact, many of the optical glasses even compare favorably with the better chemical laboratory wares such as Pyrex, Tamworth, and Kimble N–51–a. This grouping of glasses of such dissimilar chemical durabilities serves well to emphasize that the capacity of a glass to maintain a clear surface upon exposure to the atmosphere, and its chemical durability as conveniently determined, are two inherently different properties. A comparison of the hygroscopicity values of the Corning 015 electrode glass with those of the optical and chemical ware glasses, the electrode capacity of which is very poor, suggests strongly that the pH response of a glass is primarily a function of its hygroscopicity. Tests made on a limited number of glasses of the binary series Na_2O-SiO_2, K_2O-SiO_2, Li_2O-SiO_2, and PbO-B_2O_3 appear to reflect some of the critical compositions of the respective phase equilibria diagrams.

★ ★ ★ ★ ★ ★ ★

Spectrographic Determination of Boron in Steel

The addition of a few thousandths of 1 percent of boron to certain steels results in an increase in the hardenability (depth of hardening). This property suggested the possibility that boron could be substituted for considerably larger portions of strategic alloying elements in steel and, consequently, intensive studies of boron steels were made during the war period. In view of the low concentrations of boron required for optimum hardening (usually 0.001 to 0.003 percent), and the effect of variations in concentration on the properties of the steel, accurate and rapid methods were required for its determination. An investigation

of the applicability of spectrographic methods to this problem was carried out by Charles H. Corliss and Bourdon F. Scribner at the Bureau, under the sponsorship of the War Metallurgy Committee, and supported by funds allotted by the Office of Production Research and Development of the War Production Board. The report on this work will be published as RP1705 in the April Journal of Research.

The investigation showed that the sensitivity and accuracy of spectrographic methods for determining boron were affected considerably, under certain excitation conditions, by the size and shape of the steel electrode or by other variables that result in changes in its rate of cooling. These effects arise from a high volatility of boron (probably as oxide) which, in steel production, is manifested in losses from melts of steel. Advantage was taken of this volatility in the development of spectrographic methods for its determination.

Two spectrographic methods, suitable for high-speed routine analysis, were developed. The first involves alternating-current arc excitation with $\frac{7}{32}$-inch steel rods for determinations down to 0.0006 percent of boron with an average deviation of ± 4 percent. The second method applies to massive pieces of steel in any size or shape, using an overdamped condenser discharge providing sensitivity and accuracy equal to that of the first method. These methods are rapid and reliable, permitting routine determinations in the usual range of boron concentrations in less than 20 minutes per sample.

A third method, of highest sensitivity, was developed for determinations as low as 0.0001 percent of boron, or 1 part in 1 million of the steel sample. This method utilizes a direct-current arc to which sodium is added to suppress an interfering spectral line of iron arising from energy changes in the ionized iron atom. In the course of the investigation, a series of six boron steels was issued as National Bureau of Standards Standard Samples for application of the spectrographic methods in industrial and military laboratories. The six standards are in two sizes, $\frac{7}{32}$-inch and $\frac{1}{2}$-inch rods, and cover the range of 0.0006 to 0.019 percent of boron.

★ ★ ★ ★ ★ ★ ★

Corrosion of Stainless Steel Sheet in Marine Atmospheres

Under the sponsorship of the National Advisory Committee for Aeronautics, the Army Air Forces, and the Bureau of Aeronautics of the Navy Department, Willard Mutchler of the Bureau's Metallurgy Division has been studying the corrosion of thin stainless-steel sheets for use in aircraft likely to be exposed to marine atmospheres or to be wetted frequently with sea water.

Information was obtained concerning the effect of certain factors upon corrosion. Those considered were (1) the presence of small quantities of stabilizing elements in steels containing approximately 18 percent of chromium and 8 percent of nickel, (2) locality of exposure, (3) shot-welding, (4) surface finishes and treatments, and (5) contact with light metal alloys.

The 0.018-inch-thick sheet samples were exposed to the weather, and intermittently or continuously in sea water, at Hampton Roads, Va., Kure Beach, N. C., and Chapman Field, Fla. Samples were removed after approximately 6, 12, 24, and 36 months of exposure. The damage from corrosion was usually evaluated by means of flexural fatigue tests and visual examinations.

The tests disclosed that the most rapid corrosion occurred during the first 6 months exposure, and that thereafter the rate of attack was much slower. After 3 years of exposure at Hampton Roads, most of the alloys failed in fatigue tests at from 78 to 85 percent of their initial (uncorroded) endurance limits. The steels containing from 2.5 to 3.5 percent of molybdenum were much less susceptible to rusting or weathering than those containing titanium, columbium, or no stabilizing elements. None of the steels rusted appreciably when immersed in sea water. The loss in fatigue-limit values, however, was approximately the same at the three locations in both weather and sea water, indicating that pits were present. Panels exposed to the weather at Kure Beach exhibited the greatest loss and the most rust. Shot-welds were slightly more susceptible to rusting than the rest of the sheet. The amount of rust decreased, other factors being constant, as the degree of surface polish improved. Pickling prior to passivation increased the resistance to corrosion. Aluminum and magnesium alloys, especially the latter, were rapidly corroded when exposed in contact with the stainless steels. Suitable paints at the faying surfaces were adequate in preventing corrosion on the light alloys for from 6 to 12 months of weather exposure at the marine localities.

Glossmeter for Comparing Machine-finished Surfaces

A need exists for a rapid and simple production-inspection method for identifying machine-finished surfaces that are too rough to be rendered smooth by the application of single sprayed films of paint. As shininess is one indication of surface smoothness, Richard S. Hunter of the Bureau's Photometry and Colorimetry Section has tried a photoelectric glossmeter as a means of meeting this need. The results are given in the April Journal of Research (RP 1708). The roughnesses to be identified were found to be approximately a thousand times the smallest irregularities that will affect gloss. Therefore, it is necessary to coat every test surface with a thin film of liquid that fills microscopic cracks and pores, but conforms to larger surface irregularities. A near-grazing angle, 75°, was chosen for the measurement of gloss, so that specimens of the type having narrow ridges of metal between adjacent tool cuts are rated low in gloss, and therefore rough. Although the glossmeter essentially measures the fraction

of the unshadowed surface that is nearly parallel to the mean surface, the instrument resulting from the present development has proved to be a simple and useful device for making rapid comparisons of the roughnesses of surfaces machined with about the same tool feeds.

Solubility of Cadmium Sulfate in Heavy Water and in Normal Water

Determinations of the solubility of cadmium sulfate in heavy water and in normal water have been made by Langhorne H. Brickwedde as an extension of the study of the effect of heavy water on the electromotive force of the standard cells that serve as primary standards of electromotive force in this country and throughout the world.

As reported in the April Journal of Research (RP 1707), cadmium sulfate was found to be about 8 percent less soluble in heavy water than in normal water. The transition temperature for the two hydrates $CdSO_4 \cdot 8/3\ H_2O$ and $CdSO_4 \cdot H_2O$ is 43.6°C, whereas for $CdSO_4 \cdot 8/3\ D_2O$ and $CdSO_4 \cdot D_2O$, it is 45.4° C.

Calorimeter for Measuring Specific Heats of Gases

A flow calorimeter built for determining the specific heats of such gaseous hydrocarbons as butadiene, isobutene, styrene, and ethylbenzine used in the manufacture of synthetic rubber was given a thorough test with pure (electrolytic) oxygen. The test with oxygen was intended to ascertain the accuracy of the apparatus by making a comparison between the specific heats observed with it and those calculated from spectroscopic data. Measurements were made at −30°, +40°, and +80° C.

The results exceeded expectations. If the Berthelot equation of state was used to reduce the observed specific heats at the pressure of the gas in the calorimeter to values at zero pressure for comparison with the specific heats calculated from spectroscopic data, the differences between the calorimetric and spectroscopic specific heats were only a few parts in 10,000. When the Beattie-Bridgeman equation of state was used the agreement was not quite so good, especially at −30° C, where the difference amounted to about 1 part in 1,000. It is planned to try an empirical equation of state developed by C. H. Meyers, of the Bureau's Heat Division, which fits the observed *p-v-t* data for oxygen over a wide range of temperatures and pressures.

Small differences between the observed and calculated specific heats of oxygen could be accounted for by slight errors in the calibration of the thermocouple used to measure the temperature rise, so it is concluded that the fundamental design of the calorimeter is satisfactory. The principal criticism of the apparatus is that the measurements are time-consuming. Three operators are required and 3 or 4 days' work are necessary to obtain data at one temperature. Further improvements in the calorimeter should include automatic controls, to reduce the number of operators required, and a reduction of the heat capacity of the calorimeter so that measurements can be made more rapidly.

At present the apparatus is being used to measure the specific heat of isobutane, a petroleum hydrocarbon that enters into the manufacture of synthetic gasoline, and is the starting material for the manufacture of butyl rubber. The data obtained will be combined with measurements by others of the heat capacities of solid and liquid isobutane for calculating tables of its thermodynamic properties for use by chemical engineers.

Density and Heat of Combustion of Benzoic Acid

The results of various determinations of the density of benzoic acid are summarized by R. S. Jessup in RP1711, which will be published in the April Journal of Research. The three most recent results are in reasonably good agreement with each other, but are higher by about 4.5 percent than the value most commonly referred to in the literature. The difference of 4.5 percent in density affects the reduction of weight in air to mass (weight in vacuum) by an amount corresponding to 0.004 percent in mass, and in heat of combustion per gram mass.

★ ★ ★ ★ ★ ★ ★

Report on Hydrocarbon Research

A report on the status of tables of physical and thermodynamic properties of hydrocarbons and catalogs of infrared and ultraviolet spectrograms, as of January 31, 1946, was issued a short time ago by American Petroleum Institute Research Project 44, a cooperative activity maintained by the Institute at the Bureau and at the University of California.

The report gives a short history of the project; its aims; the properties that have been and are being investigated; the reasons why infrared and, later, ultraviolet spectrograms were collected and distributed; and the use of the tables, which provide "complete, accurate, and self-consistent sets of values of the physical and thermodynamic properties of hydrocarbons." A list of applications that have thus far been found for the tables includes seven important lines of work.

It is pointed out that until recenly all the tables were placed in the class of restricted information. Now,

however, they have been declassified so that "the values may be used freely and quoted in publication." Suggested forms of reference will be supplied on request. The contribution of unpublished data by any laboratory interested in the work is solicited. All such contributions should be addressed to Frederick D. Rossini, API Research Project 44, National Bureau of Standards, Washington 25, D. C.

The project is headed by an advisory committee composed by Wayne E. King, of the Texas Co., chairman; Otto Beeck, of the Shell Development Co.; Gustav Egloff, Universal Oil Products Co.; and Stewart S. Kurtz, of the Sun Oil Co. Its research staff at the Bureau is made up of Frederick D. Rossini, supervisor; William J. Taylor and John E. Kilpatrick, research associates; Joan M. Pignocco, research fellow; and Mary A. Greaney, junior research fellow. Those at the University of California are Kenneth S. Pitzer, associate supervisor; and Charles W. Beckett, research associate. Consultants at the Bureau are Carl S. Cragoe, Edward J. Prosen, and Donald D. Wagman.

Examples of the tables, lists of the compounds the spectrograms of which have been cataloged, and typical spectrograms are attached to the report.

As explained in the report, the API and the Bureau have arranged for the following distribution of the tables and spectrograms:

1. Copies of tables and spectrograms will be supplied to all U. S. Government laboratories having a need for them, free of charge, on application to the Bureau.

2. One set of the tables and spectrograms will be supplied, gratis, to each department of chemistry and department of physics in universities and colleges, with the compliments of the API and the Bureau, on application to the latter.

3. Up to 10 copies each of the tables and spectrograms will be supplied, free of charge, to each of the supporters of the research fund of the API, on application to the Institute.

4. Additional sets of the existing tables and spectrograms, as well as new tables and spectrograms to be issued, may be obtained by individual research workers and by laboratories in industry, research institutions, and universities, from the American Petroleum Institute, attention of D. V. Stroop, 50 West 50th Street, New York, N. Y., at the following prices:

Number of copies	Tables per sheet (in complete sets only)	Spectrograms per sheet (in complete sets only)
1 to 9	3 cents	5 cents.
10 to 49	2½ cents	3½ cents.
50 to 99	2 cents	3½ cents.
100 or more	1½ cents	3½ cents.

★ ★ ★ ★ ★ ★ ★

Spectrophotometric Determination of Titania in Portland Cement

Titania is one of the minor components of portland cement. Neither the present Federal specifications for cement nor those of the American Society for Testing Materials contain any requirements for titania content, nor do the specifications for the analysis of cement contain any method for its determination. The specifications provide for the determination of the percentage of Al_2O_3 indirectly, as the different between the percentages of R_2O_3 and Fe_2O_3. If the titania in a cement is thus ignored, it is evident that the percentage of Al_2O_3 found, and the calculations of the potential compound composition of the cement, which are partially based on the Al_2O_3 content, will be in error.

J. J. Diamond, of the Clay and Silicate Products Division, in an article submitted for publication in Rock Products, describes a simple and precise method for determining titania in cement. It involves fusion of the R_2O_3 obtained from the cement with $K_2S_2O_7$, solution of the melt in 1: 9 H_2SO_4, and reaction with hydrogen peroxide to form a yellow to amber complex. The color intensity is measured spectrophotometrically. A compensating blank technic is used to eliminate the interference due to the presence of iron and other coloring matter.

The R_2O_3 separation was adopted for three reasons. First, as R_2O_3 is often determined in the routine analysis of cement, the proposed method can easily fit into the regular scheme of analysis. Second, the method can easily be adapted to the analysis of many ceramic and other materials. Third, it results in a method that is quite precise and accurate. Average deviations from the mean of 0.003 percent or less were obtained by three chemists in multiple analyses of cements ranging in titania content from 0.17 to 0.33 percent. Results obtained on Bureau's standard samples are in good agreement with the certificate values.

Absorption and Scattering of Sound by Cylinders

Acoustic materials that are used to reduce noise and control reverberation in rooms are usually applied directly to walls and ceilings. Recently, a manufacturer has developed an acoustic treatment in which the sound-absorbent material, in the shape of long circular cylinders, is located at a distance from the walls. The system is applicable to rooms in which acoustic materials cannot be applied in the conventional way.

The absolute sound absorption of such cylinders must be determined in order to know how they will influence the acoustics of rooms in which they are installed. Two different methods of determination can

be used. In the first—direct experimental measurement of absorption—the cylinders are placed in a reverberation room, and the time required for sound to die away by a known amount is measured. The second method involves a theoretical calculation of the absorption by supposing a plane wave of sound to strike the cylinder and to be absorbed and scattered. In order to effect the calculation, the acoustic impedance of the material composing the cylinder must be measured first.

Such measurements and calculations were made by Richard K. Cook and Peter Chrzanowski, of the Bureau's Sound Section, on some cylinders constructed of Fiberglas and on others made of hair felt. A statistical study was made of the random waves in a reverberation room in order to compare the absorption coefficients obtained by the two methods.

As reported in the Journal of Research for April (RP1709), it was found, both experimentally and theoretically, that cylinders can have absorption coefficients greater than unity. This means that such cylinders will have more sound absorption than an opening in a wall, the area of which is equal to the peripheral area of the cylinder. The enhanced absorption results partly from the fact that diffraction of sound around the cylinder takes place, and partly because sound waves can approach a cylinder from all directions in a reverberation room.

The experimental and theoretical absorption coefficients agreed fairly well. The differences, however, were greater than the experimental uncertainty. The most likely explanation of these differences is that the absorption is governed not only by the acoustic impedance of the material, but also by the way in which sound is propagated through the absorbent material in directions tangential to the surface.

Dynamic Tensile Tests of Parachute Webbing

Lengths of parachute webbing are the links between the parachute and the harness attached to the falling man or parcel. The webbing must be strong enough to safely carry the forces on it as the parachute opens, and springy enough so that the man is uninjured. The Bureau of Aeronautics of the Navy Department wished to know what characteristics nylon and cotton webbing had when dynamic loads were applied. Some of the answers may be found in a paper by Ambrose H. Stang, Martin Greenspan, and Sanford B. Newman (RP1710) in the Journal of Research for April. The stretch for different loads and the amount of energy absorbed were calculated from autographic load-time curves taken as dynamic loads applied to the webbing. The dynamic load that broke the webbing was also obtained. The nylon- and cotton-webbing specimens were about equal as to the dynamic breaking loads, but the nylon webbing absorbed more than three times as much energy as the cotton webbing before failure occurred.

★ ★ ★ ★ ★ ★ ★

Instrument Tests for Aircraft Speed and Altitude Trials

An elaborate procedure has been set up by the Federation Aeronautique Internationale (FAI) to govern the speed and altitude trials of aircraft when international recognition is desired for the records obtained, and the same procedures are followed even though only national recognition is sought. Both types of trials are under the cognizance of the National Aeronautic Association (NAA), the United States representative of the FAI. The pressure- and temperature-recording instruments carried in the flights are tested in the Bureau's Aeronautic Instruments Section for the NAA, and the necessary computations made or conclusions drawn.

In cross-country speed trials it is only necessary to determine the time between take-off and landing indicated by the barograph, and whether or not intermediate landings are indicated, which is usually obvious from an inspection of the flight trace. Since December 1, 1945, barographs carried on eight such flights have been tested. Altitude trials are in two classes. In the first, air-temperature and air-pressure data recorded in flight are used to compute the tape-line altitude above sea level; in the second class, only the air pressure is measured, from which the altitude in the FAI standard atmosphere is computed. It is required that the instruments be tested both before and after the flight.

Tests have just been completed to determine the altitude, from barograph indications only, for three helicopter flights made at the Sikorsky airport. The barographs were given a "flight-history" test in which the barograph is subjected simultaneously to the air pressure and barograph temperature encountered during the flight. The indications of the barograph and of the calibrated mercurial barometer are observed at the point of take-off and at the highest altitude. From the altitudes in the FAI standard atmosphere corresponding to these pressures, the official "altitude" was computed.

Altitude trials of the first class described are being projected, in which the technic of securing the necessary temperature and pressure data and the testing are relatively complicated. The Bureau is being consulted frequently on the instrument problems, with testing to follow in due course.

Tests of Airplane-Weighing Scales

A short time ago, H. H. Russell, acting chief of the section on large-capacity scales, tested four airplane-weighing scales comprising the more important weight-control units of the Flight Test Section at the Patuxent River Naval Air Test Center, thus completing the first "maintenance" tests made on these scales since they were installed in November 1943.

In view of the fact that these scales had been in continuous service for a period in excess of 2 years without interruptions for repairs, adjustments, or maintenance operations of a special nature, it was decided to make very thorough tests at this time, utilizing known-load tests corresponding to the rated capacity in each instance. The test load assembled and transported to Patuxent River for the purpose totaled 80,000 pounds—probably the largest test load of known value ever assembled for the testing of any scale other than a railway track scale.

The results of the tests were very satisfactory, and indicate that properly installed scales of the two-section type with a simple unnotched weigh beam, employing counterpoise weights as the major weight-indicating elements, are susceptible of meeting the accuracy requirements for master railway track scales.

New Mathematical Tables

Five additional tables prepared by the Bureau's Mathematical Tables Project have been published since the announcement carried in Technical News Bulletin No. 340 (August 1945). The following three are available from the Bureau at 25 cents each, in the form of reprints from the Journal of Mathematics and Physics:

MT34. Inverse interpolation for eight-, nine-, ten-, and eleven-point direct interpolation.

MT35. Table of coefficients for double quadrature without differences, for integrating second order differential equations.

MT36. Formulas for direct and inverse interpolation of a complex function tabulated along equidistant circular arcs.

Two (these are books bound in red buckram and do not carry "MT" numbers) are available from Columbia University Press, Box F483, 2960 Broadway, New York 27, N. Y. Their titles and prices are:

Table of arc sin x. Price $3.50.

Tables of associated Legendre functions. Price $5.

New and Revised Publications Issued During March 1946

Journal of Research [1]

Journal of Research of the National Bureau of Standards, volume 35, No. 6, December 1945 (RP1681 to RP1687, inclusive). Price 30 cents. Annual subscription, 12 issues, $3.50

Journal of Research of the National Bureau of Standards, volume 36, No. 1, January 1946 (RP1688 to RP1692, inclusive). Price 30 cents.

Research Papers [1]

(Reprints from November 1945 Journal of Research)

RP 1677. Effect of pressure on the melting of crystalline rubber. Lawrence A. Wood, Norman Bekkedahl, and Ralph E. Gibson. Price 5 cents.

RP1678. Second dissociation constant of o-phthalic acid and related pH values of phthalate buffers from 0° to 60° C. Walter J. Hamer and S. F. Acree. Price 10 cents.

Simplified Practice Recommendations [1]

R77–45. Hickory handles. (Supersedes R77–39.) Price 5 cents.

R144–45. Paints, varnishes, and related products (colors and containers). (Supersedes R144–43.) Price 5 cents.

R213–45. Asphalt roll roofing and asphalt- and tar-saturated-felt products. Price 5 cents.

Technical News Bulletin [1]

Technical News Bulletin 347, March 1946. Price 5 cents. Annual subscription, 50 cents.

Mimeographed Material

Weights and Measures News Letter No. 41 issued by the National Bureau of Standards in cooperation with the National Conference on Weights and Measures. (National Bureau of Standards, Washington 25, D. C.), (November 1945–February 1946.) Obtainable without charge from the Bureau.

Recent Articles by Members of the Bureau's Staff Published in Outside Journals [2]

The impact of war on science. Lyman J. Briggs. Industrial Standardization (Am. Standards Assn., 70 East Forty-fifth Street, New York 17, N. Y.). 17, No. 1, 8 (January 1946).

Heliographic signaling mirrors. Richard S. Hunter. (Air Sea Rescue Agency, 1516 Fourteenth Street, N. W., Washington, D. C.). 3, No. 3, 24 (March 1946).

Mica delamination aided by science. D. W. Kessler. Domestic Commerce (Department of Commerce, Washington 25, D. C.). 34, No. 3, 14 (March 1946). (Available from Superintendent of Documents, Government Printing Office, Washington 25, D. C. at 10 cents each.)

[1] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Subscription to Technical News Bulletin, 50 cents per year; Journal of Research, $3.50 per year (to addresses in the United States and its possessions and to countries extending the franking privilege); other countries, 70 cents and $4.50, respectively.

[2] These publications are not obtainable from the Government, unless otherwise stated. Requests should be sent direct to the publishers.

U. S. GOVERNMENT PRINTING OFFICE: 1946